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Do birth order and family size matter for intergenerational income mobility? Evidence from Sweden

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Abstract

Previous studies of intergenerational income mobility have not considered potential birth- order or family-size effects in the estimated income elasticity. This paper uses a large sample of individuals born between 1962 and 1964; income elasticities with respect to parents' incomes are estimated for individuals with different birth-order positions and family sizes. Results based on labor income and total income for sons and daughters are reported separately. The elasticity tends to decrease with family size as well as with birth order for a given family size, especially in the labor-income analysis of fathers and sons.

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1. Introduction

Rising interest in intergenerational income mobility has generated many studies of the relation between the long-run income of parents and children.[1] The interest in the transmission of economic status from one generation to another is generally motivated by a wish to determine the degree of equality of opportunity. The extensive Swedish welfare system is partly interpreted as a desire to promote equal opportunities: for instance, most schools are publicly financed and higher education is free of charge to reduce the importance of family background. In this way, studies that examine the intergenerational income mobility can be useful as *equality barometers* in society.

The empirical studies in this area have not yet considered potential birth-order or family-size effects in the income relation of parents and children. Children's similarities to their parents and their tendencies to approach a similar income level may, to some degree, depend on whether or not they are the only child in the household. The presence of several siblings reduces the time that the parents are able to devote to each child. The unique position in the birth order of each child may also have an impact on this process. For example, first-born children grow up in more adult-oriented environments than later-born children. Earlier studies of intergenerational income mobility only provide average income elasticities over individuals from all categories of birth-order positions and family sizes.

The focus in this study is to find out whether or not income elasticities for individuals with different birth-order positions and family sizes deviate from the average income elasticity. To my knowledge, this is the first paper that poses this question and the lack of research is probably due to researchers being dependent on surveys with limited sample sizes. This study is based on large register-based data sets that permit separate analysis of small subgroups. The first part of the analysis provides

[1] See Solon (1999) for a survey.

conventionally estimated average income elasticities with respect to the father's and the mother's income for both sons and daughters. The second part of the analysis allows for birth-order and family-size differences in the estimated elasticities. Throughout the paper, family size refers to the number of biological whole-siblings in the family. Fathers' and mothers' incomes are used separately in the analysis and several income restrictions are applied in order to deal with the fact that many mothers worked part-time in the 1970s.

The average income elasticity in Sweden for fathers and sons is estimated to be around 0.25 (Björklund and Jäntti 1997, Björklund and Chadwick 2003).[2] Coach and Dunn (1997) estimate the German father-son income elasticity to 0.11 and Dearden *et al.* (1997) report a British estimate of 0.57. In the US, the elasticity for fathers and sons is estimated to be around 0.40, and the estimates for fathers and daughters were about the same (Solon 1992, Zimmerman 1992, Eide and Showalter 1999, Chadwick and Solon 2002).[3] Using a 16-year average of fathers' earnings, Mazumder (2005) estimates the US elasticity for fathers and sons to 0.60. In Canada, finally, the elasticity for fathers and sons is about 0.20 (Corak and Heisz 1999).

So there are considerable country differences in the average intergenerational income elasticity and still, there is little knowledge about what actually drives the transmission of income. Allowing for birth-order and family-size differences is one way to learn more about the mechanisms behind the transmission of economic status between generations. For example, if there were large differences in the income elasticity in large and small families, it could be motivated to go further and investigate if there is a pattern in the intergenerational income elasticity among countries with different fertility rates. If the

[2] Österberg (2000) presents a much lower estimate, 0.13. Grawe (2006) organizes estimates of intergenerational earnings elasticity by mean age of fathers and finds a pattern of low elasticity in samples with old fathers. Considering that Österberg observes fathers late in the lifecycle, Grawe concludes that her result is not to be seen as an outlier. Österberg also includes non-biological fathers which is likely to reduce the elasticity. See Österbacka (2001) for results on Finnish data.
[3] See e.g. Becker and Tomes (1986) for an overview of results from 1970s and 1980s.

income elasticity to some degree is connected to fertility rates, this might help explain the different income elasticity levels in countries with varying fertility rates. On the other hand, if there are no differences in the elasticity in large and small families, the reason to the country differences in intergenerational income elasticity has to be searched for elsewhere. The next section discusses why we might expect birth-order and family-size effects in an intergenerational context; section 3 provides a short overview of the existing literature on birth-order and family-size effects on the level of earnings and educational attainment. Section 4 presents the econometric framework for estimating average income elasticities and income elasticities by birth order and family size. Section 5 describes the data and the sample selection, section 6 presents the empirical results and section 7 concludes the paper.

2 Birth-order and family-size effects

Earlier research discusses a number of ways that birth order can affect individuals' future income levels. Ejrnaes and Pörtner (2004) divide them into the following main categories: constraints, household environment and cultural factors. These categories are to some extent also relevant for the discussion of family size.

Financial constraints and imperfect capital markets may reduce opportunities to equalize expenditures on children and therefore opportunities for children may vary, depending on the birth-order position. Further, when the first child is born, many parents are at the start of their careers, while later-born children may arrive when the parents are closer to the peak of their careers and earnings profile, especially if there are several children in the household (Behrman and Taubman 1986). This may favor later-born children compared with earlier-born ones.

From the perspective of constraints, it may be that high-income earners have fewer children on average and more resources to spend on each child, compared to low-income

earners. Studies have shown that the highest income elasticities between generations are estimated at the top of the parents' income distribution in Sweden (Österberg 2000). This predicts a negative relation between the number of siblings and income elasticity.[4]

The household-environment explanation suggests that the specific number of siblings and ages of siblings affect the environment in which the children grow up. Initially, first-born children spend more time alone with their parents, because there are no other siblings with whom to compete for parents' attention. It has been argued that last-born children may also have this advantage (Hanushek 1992). This is a reasonable argument if there is a large age difference between the second-to-last and the last-born child.

Parental separation is another aspect connected to the household-environment explanation. Separation from the father—which is still the most common outcome—may decrease the father's influence on the children. Because of this, lower income elasticity between children and absent fathers may be expected. Björklund and Chadwick (2003) find large differences in the income elasticity in father-son samples depending on the amount of time they had lived together. For sons who had never lived with their biological fathers, the elasticity was equal to zero. Beyond this general effect, separations may also generate birth-order differences in the income elasticity, especially if there are large age differences between the siblings. Later-born siblings are younger at the time of the separation, so they have a shorter experience of living in the same household as their father, compared with older siblings. Therefore, a weaker income relation between the father and the later-born siblings may be expected. This will be referred to as a separation hypothesis.

Sulloway (1997), a leading debater about the significance of birth order, argues that first-born children are more likely to identify with authority than their younger siblings.

[4] However, such a finding would, at least to some degree, depend on the model being incorrectly specified and using more flexible functional form may yield a different result.

Clausen (1966) discusses the tendency of parents to delegate parts of their authority over younger children to the first-born child. He suggests that first-born children tend to recognize and accept parental authority more than later-born children. It has also been argued that since first-born children grow up in an adult-oriented environment, they tend to imitate their parents more than their younger siblings (Behrman and Taubman 1986).[5] A related discussion concerns role models and the idea that younger siblings might consider older siblings as role models and identify with them, which reduces the relative influence from the parents.

Differences in the family environment that depend on family size may occur because parents with several children have less time to devote to each child. The observation that economic and social family resources become diluted as the family grows is described as a trade-off between "child quantity and child quality" (Blake 1989). Hanushek (1992) develops a family maximization model based on a theory presented by Becker (1960) and Becker and Lewis (1973) and belongs to both the family environment and the constraints category. It distinguishes between *public time*, which the family spends together, and *private time*, which a child spends alone with one or two parents. Naturally, the amount of public time does not necessarily decrease with the number of children in the family, unless the parents must work more to support a larger family, while the amount of private time is likely to do so. One hypothesis is that there is less parental influence on children in large families, which may generate weaker income relations. The intergenerational income elasticity would then again be expected to decrease with family size; accordingly, children without siblings would be expected to exhibit the largest income elasticity.

Finally, birth-order effects may also be due to cultural factors. For example, among farmers, there is an old tradition that the eldest son inherits the farm. This agricultural habit is also common when private companies are inherited within a family. If this

[5] Behrman and Taubman (1986) point out that these arguments date back to Galton (1874).

tradition still exists, it may be reasonable to predict higher income elasticity among first-born children.

3. Previous research on birth-order and family-size effects

While no previous paper has focused on intergenerational income elasticity by birth order and family size, there is an extensive literature covering birth order and family size effects on the individual's own wage level, education level, and schooling performance. Lindert (1977) finds a negative relation in US data between family size and the expected years of schooling. His results also indicate significant sibling position effects on schooling performance, where first-born children in large families have an advantage over middle-born children. These results are confirmed by Behrman and Taubman (1986) who also report birth-order differences on the effect on earnings, but these effects become insignificant when controlling for family size. Kessler (1991) does not find any significant birth-order or family-size effects on the level or growth of wages in US data. In the study by Hanushek (1992), positive effects on schooling performance by being the first-born are detected in US data, but in the next step, these effects are entirely explained by the first-born's higher probability of belonging to small families. Black *et al.* (2005) find a negative correlation between family size and children's education, but with the inclusion of birth order variables, the family size effects disappear.[6]

Björklund and Jäntti (1998) find that children from large families in Sweden, Finland, and the US can expect to earn less than children from small families. Björklund *et al.* (2004) study the relation between birth order, family size and gender composition and earnings in Sweden, Finland and Norway. They find that those who belong to a family of two children have 10 per cent higher earnings than those who belong to a family of five or more children, while the earnings differential by birth-order and gender

[6] Black *et al.* use twin data to address this issue, so the ambition is to study causal effects.

composition was small. Finally, Raaum and Aabo (2001) find that first-born children in Norway obtain more education than their siblings. Overall, these findings indicate the importance of integrating the birth-order and family size analyses, in order to avoid mistaking one effect for another. Further, the above studies show that birth order and especially family size, seems to matter for the individuals' future outcomes. Now the question is if they also matter for the intergenerational income relation.

4. Empirical framework

A traditional model of the relation between the income of parents and children is

(1) $$Y_{ci} + \alpha + \beta Y_{pi} + \varepsilon_i$$

where Y_{ci} is the long-run log income of child c in family i, Y_{pi} is the long-run log income of parent p in family i, and ε_i is a random component distributed as $N(0, \sigma^2)$. β measures the elasticity of the children's income with respect to parents' income. Consequently, $(1-\beta)$ refers to the degree of income mobility. If the children's income has the same variance as the parents' income, β also equals the intergenerational correlation. If the variances differ, the correlation can be obtained by multiplying the elasticity coefficient by the ratio of the standard deviations of the parents' and the children's incomes.

Income averages taken over several years are used in estimation because they produce a better measure of long-run income than single-year measures of income (Solon 1992). A parent's income is usually measured later in the life cycle compared to the children, so therefore intergenerational income mobility studies usually include age controls in the regressions to adjust for the life-cycle variation in income of both generations. In the present study, children are of similar age and therefore the age variables for children are not included. Least squares is applied to the regression

$$(2) \qquad Y_{ci} = \beta_0 + \beta_1 \overline{Y}_{pi} + \beta_2 \overline{A}_{pi} + \beta_3 \overline{A}^2_{pi} + \varepsilon_i$$

where Y_{ci} is the son's (daughter's) log income in 1999 and $\overline{Y}_{pi}$ is the average of the fathers' (mothers') log incomes in 1970, 1975, 1980, 1985 and 1990. $\overline{A}_{pi}$ is the fathers' (mothers') average age during the income years and $\overline{A}^2_{ci}$ is the average of the fathers' (mothers') squared age during those years.

Note that the left hand side variable is current income of the young generation in 1999 instead of an income average. Income of the young generation is also available in 1996, but the choice to use current income is made in order to measure income at a time when the individuals in the sample have reached a higher age level.[7]

A previous finding is that the intergenerational income elasticity tends to rise with the average age of the children in the sample (Reville 1995). There is then an obvious risk in this type of analysis that age effects are mistaken for birth-order effects. One solution is to use individuals of similar age but who still have different birth-order positions and belong to families of different sizes. To allow for birth-order and family-size effects, individuals of similar age are divided into sub-samples, depending on birth-order position and family size.[8] Separate regressions are then run based on these samples: children without siblings; first-born children in two-child families; second-born children in two-child families; and so forth. In this way, the individual's birth order and family size are integrated in the estimation of intergenerational income elasticity.

[7] Using a two-year average of income in the dependent variable does not change the results in the analysis.

[8] Note that the individuals in the study are not related to each other and that gender composition is not taken into account.

5. Data

5.1 Description of data and sample selection

The data used in this study are entirely based on administrative records kept by Statistics Sweden. The analysis is based on a random sample of individuals born in Sweden between 1962 and 1964, and their parents. All together, they amount to nearly 74,000 individuals. Information on family size and birth order of the young generation is collected from the second generation register. Note that the siblings of the individuals in the sample may be born before 1962 or after 1964. In fact, births are registered in the data from 1932 to 1998, so the parents in the study are likely to have completed their child-conceiving years. Half siblings and adopted children can be identified in the data, but only biological whole-siblings are included in the analysis. The reason is that an individual probably has more in common with a biological sibling than with a half sibling or adopted sibling. In order to make the results of the analysis easier to interpret, families where the biological siblings also have half siblings or adopted siblings are excluded.

Income data are gathered from registers based on employers' compulsory reports to the tax authorities. The income variables are annual labor income—including sickness benefits, parents' allowances, and income from farming activity—and total income, which includes annual labor income, pensions, unemployment benefits, capital income (including realized capital gains), and income from real estate property (*inkomst av annan fastighet*).[9] For the young generation, income is measured in 1999, while it is measured over five years for the parents - in 1970, 1975, 1980, 1985, and 1990.

A few restrictions are imposed on the samples used in estimation. As mentioned, the analysis is based on children who are born between 1962 and 1964. Still, full information on birth order and the number of siblings of these individuals is used. An age restriction

[9] Total income in 1970 is the net of deductions while total income in 1975 and 1980 is not. The difference, however, is expected to be very small.

on the parents is applied, including those born in 1925 and later and the parents are also required to be alive in 1990.[10] The former restriction is applied in order to exclude most parents who reach pension age before 1990.

As a baseline income restriction, the children are required to have a positive income in 1999, while the parents are required to have a positive average income over the income years. One could argue that only parents who have a positive income every year should be included. There is a trade-off between achieving a good measure of long-run income—which is promoted by including as many income observations per individual as possible—and avoiding that the sample is biased toward high-income earners. Including only those individuals who report positive income in all years produces a better measure of long-run income. But excluding those who have experienced unemployment would increase the sample's average income since more low-income earners become unemployed. This, in turn, might alter the estimated income elasticity because high-income earners tend to have higher income elasticity (Österberg 2000). Over-sampling high-income earners might also alter the analysis of family-size effects because high-income earners tend to have fewer children. Österberg (2000) presents results using both types of income restrictions. The restriction that requires a positive income every year produces slightly higher estimates of income elasticity for fathers and sons. Also this study presents results using both types of income restrictions. Further, because many mothers worked part-time during the 1970s and 1980s, the analysis also elaborates with income restrictions of 10,000 and 100,000 SEK per year, in order to study the income relation between people who were active on the labor market.

Previous studies have shown large differences in the income elasticity of sons and daughters, see Österberg (2000). So the analysis should be made separately for sons and daughters. Table 1 presents sample characteristics of sons and daughters. For the

[10] The age restriction of fathers reduces the father-son sample from 20 150 to 18 002 observations.

complete sample, the average annual labor income in 1999 for sons is SEK 262,000 (EURO 28,000) and for daughters SEK 171,000 (EURO 18,000). Income averages, according to birth order and family size, indicate that the average income decreases with family size, and for a given family size it also decreases with birth order. Table 2 shows sample characteristics of the parents. The fathers' average annual labor income is SEK 238,000 which is slightly lower than the sons' average income, while the mother's average income is SEK 98,000. The average age of the fathers in 1980 is 45.7 while the average age of the sons in 1999 is 36 so the age difference between the generations at the time the income data are collected, is unusually low in this study.

5.2 Measurement errors

The estimation of the intergenerational income relation is subject to attenuation bias due to both classical and non-classical measurement errors. On the left hand side, classical measurement errors should not lead to biased estimates in the regression context. Non-classical measurement errors, on the other hand, may induce lifecycle bias. In the analysis of their youngest cohort, Böhlmark and Lindquist (2005) find that current income captures lifetime income reasonably well for Swedish men around age 34. This cohort is also the one most comparable to the samples in this study. Therefore, the income variables of the young generation in this paper, whose average age is 36, are not likely to suffer from any serious lifecycle bias.

On the right hand side, the use of a short-run measure of parental income would lead to a downward bias in the estimation of intergenerational elasticity. This problem is reduced by using an average of income from five years over a period of 21 years. Even though data are not available for each of the 21 years, it can be argued that using data from five years over such a long period of time is preferable to five years in a row. If the

income data is subject to a shock during a particular period, this may not affect the average very much when income from the other years are included.

The income of parents who are especially young or old may not be a good proxy for long-run income. Grawe (2005) organizes estimates of intergenerational earnings elasticity by mean age of fathers and finds a significant negative relationship between the earnings elasticity and the age of the fathers in the sample. Section 6.3 deals with this problem by running regressions based on samples excluding both the youngest and oldest fathers. This section also runs regressions where the father's incomes are collected at different points in time, in order to obtain similar age of the fathers in estimation.

6. Results

6.1 Average elasticities

Table 3 presents estimates of average intergenerational income elasticities using several income restrictions. The dependent variable is the sons' or daughters' log labor or total income in 1999. The fathers' and mothers' income is an average of log income from five years over a period of 21 years. The regressions also include a constant and age and age squared of fathers/mothers. For fathers and sons, an income elasticity of 0.28 is estimated in the regression based on labor income where a positive income is required for at least one year. This estimate is similar to those found in Björklund and Jäntti (1997) and Björklund and Chadwick (2003).

The requirement of positive income in all years for the fathers produces a larger estimate for labor income and total income, which is also the finding in Österberg (2000). Further, it is shown that the intergenerational income elasticity is stronger for labor income than for total income. This result might be expected because total income includes more public benefits than labor income. Low elasticity for total income may

follow from a situation where income to a large extent is determined by the welfare state rather than by the parent's income level.

For fathers and daughters, an income elasticity of 0.204 is estimated in the regression based on labor income where positive income is required for at least one year. As in the case of fathers and sons, the income relation is stronger for labor income than for total income. In the analysis of individuals with annual income above SEK 100,000, the estimates are slightly higher both for fathers and sons and fathers and daughters. The difference in not very large, except for the total income estimates. They increase to 0.396 for fathers and sons and to 0.289 for fathers and daughters.

In the analysis of the income relation between mothers and sons and daughters, it is clear that the choice of income restriction matters a lot. The regressions in row 1-3 yield low estimates for both sons and daughters, comparable with those reported for similar income restrictions in Österberg 2000. Including only those with an income above SEK 100,000 yields considerably larger estimates, 0.213 for mothers and daughters and 0.266 for mothers and sons in the labor income regression. So, when using a sample of mothers that mainly work fulltime, the influence of the mother's income on her children's income is almost as large as the influence of the father's income.[11]

6.2 Elasticities by birth order and family size

Table 4 presents regression coefficients from estimations of the intergenerational income elasticity by birth order and family size for both fathers and sons and fathers and daughters. Column one and row one show the estimate for sons/daughters without siblings; column one and row two show the estimate for first-born sons/daughters in

[11] The average income of the mothers in this sample is SEK 191,000 (st. error 60,000), so it is reasonable to assume that most mothers work full-time.

two-child families; and so forth.[12] The overall tendency in the father-son analysis is that the elasticity decreases with birth order for a given family size, especially in large families. In three-child families, the estimate for first-born sons deviates largely from the estimates for middle-born and last-born sons: the former estimate is almost twice as large as the latter. The far-right column provides estimates for different family sizes regardless of birth order. Disregarding children without siblings, the elasticity tends to decrease with family size. The estimates for fathers and daughters show a similar but weaker elasticity pattern regarding birth order, but there are no differences in the elasticity connected with family size.

Regressions are also run where the fathers are required to have had a positive labor income in all income years and these results are found in appendix table A1. The estimates are similar compared to those in table 4, but the elasticity reduction by family size is a little smaller. Yet another regression uses total income rather than labor income. Because total income also includes unemployment benefits, individuals who have experienced unemployment are included in this analysis.[13] The results show that the elasticity decreases with birth order for a given family size, but the decrease is smaller compared to the labor-income analysis. For fathers and daughters, there is no pattern in the income elasticity. These results are found in appendix table A2.

Table 5 presents the results from regressions based on mother-son and mother-daughter samples. The estimation of an intergenerational income relation where one generation works part time to a large extent while the other does not, would be hard to interpret, therefore an income restriction of SEK 100,000 is applied. Consequently, the number of observations is much smaller and the division into family size and birth order position is done in fewer categories. For mothers and sons, the birth-order pattern is

[12] Note that sex composition is not taken into account here; for instance, first-born sons may have either younger sisters and/or younger brothers.
[13] In the labor-income analysis, fathers who have experienced unemployment are included as long as a positive income is reported for at least one of the income years.

rather the opposite compared to the result in table 4, the elasticities tend to increase with birth order and family size. The result for mothers and daughters on the other hand, shows no family-size effect and no clear pattern in the elasticity according to birth order, even though the elasticity of last-born daughters in families with three or more children is very low.

6.3 Significance tests of the birth-order and family-size effects

The question is whether the estimates of birth-order and family-size effects are significantly different from each other. The procedure is then to test a restricted model, including only one parameter for parent's income, i.e. the case where the same elasticity for all birth orders and family sizes is assumed (cf. table 3), against a more general model. The general model allows each birth-order and family-size combination to have its own parameter for family income, (cf. table 4). In order to perform the tests, the data are pooled and regressions where birth-order and family-size variables are interacted with the parent's income are run as follows:[14]

$$(3)\qquad \begin{aligned} Y^c = {} & \alpha + \beta Y^p + \delta^2 Z^2 Y^p + \delta^3 Z^3 Y^p + \delta^4 Z^4 Y^p \\ & + \lambda^2 O^2 Y^p + \lambda^3 O^3 Y^p + \lambda^4 O^4 Y^p \\ & + \phi^{22} Z^2 O^2 Y^p + \phi^{33} Z^3 O^3 Y^p + \phi^{42} Z^4 O^2 Y^p \end{aligned}$$

where Y_c and Y_p are the income of children and parents as before and Z and O represent size and order. For example, $\phi^{22} Z^2 O^2 Y^p$ indicates the effect of parent's income for children with birth order two in families with two children. δ, λ and ϕ are estimated parameters.

Table 6 reports tests and p-values referring to the labor-income analysis of the father-son sample. Test 1 shows that a restricted model that ignores birth-order and

[14] The following variables are included in regression but excluded in presentation: simple dummy variables for order and size, order*size, age, age-squared, age variables interacted with order and size. This regression yields exactly the same estimates and standard errors as those in table 4.

family-size effects is rejected at the 1% significance level. Test 2 and 3 are performed in order to find out if either birth order or family size is more important then the other. Test 2 shows that a model that includes the size-income interactions but ignores the order-income interaction as well as the order-size-income interaction is significant at the 10% significance level. Finally, test 3 shows that we can not reject a model that includes the order-income interactions but ignores the size-income interaction as well as the order-size-income interaction at conventional significance levels. So, together, the birth-order and family-size variables contribute to the model, but the evidence is much weaker when the separate effects of the two variables are analyzed.[15] In the father-daughter, mother-daughter and mother-son samples, there are no significant birth-order or family-size effects.

To summarize, a traditional analysis that measures the average elasticity of labor income (table 3), shows an elasticity of 0.28 for fathers and sons and 0.20 for fathers and daughters. In the mother-son and mother-daughter samples, the elasticity is only 0.04 when positive income is required for at least one year. When an income above SEK 100,000 is required every year, the elasticity is 0.27 for mothers and sons and 0.21 for mothers and daughters. When allowing for family-size effects, the elasticity tends to decrease with family size for fathers and sons. Further, allowing for birth-order effects within each family size leads to estimates that decrease with birth order, especially in the labor income analysis. For fathers and sons, the estimates of first-born children are between two and three times the size of the estimates for last-born children in large families. The results for fathers and daughters are similar but weaker.

[15] The effects are not fully separated since the size-order-income interactions are included. It is also worth noting that separation of the birth-order effects from the family- size effects is complicated by the fact that being, for example, the fourth child implicates that the child comes from a family of at least four and so on.

6.4 A closer look at the birth-order pattern

This section tries to understand why income elasticity tends to decrease with birth order for a given family size. As mentioned in section 4.2, the intergenerational income elasticity tends to rise with the average age of the children in the sample. Further, Grawe (2006) finds that the elasticity decreases when fathers are observed late in life rather than early, so the age of both generations seems to be crucial. In the birth-order and family size analysis, the father's age varies depending on the child's birth-order position because fathers of children with high birth order are, on average, older than fathers of first-born children. To find out if the results are sensitive to the age of the fathers, regressions are run based on samples excluding both the youngest and oldest fathers. The results are not sensitive to the exclusion of fathers who were age 50 or older in 1980, or the fathers who were age 35 or younger in 1980.

A more careful way to address this problem is to measure income earlier for some fathers. Table 2 shows fathers' average age by birth order position of their children. If the income in 1990 is dropped from the average income for fathers of children with position 2 in the birth order, these fathers' average age over the income years drops from 46.8 to 44.3. Similarly, if the incomes in 1985 and 1990 are dropped for fathers of children with position 3 and 4+ in the birth order, an average age of 44.5(+/- 1) years is attained for all fathers in the sample. With this method we will of course have to accept potential problems of measuring income at different times, but the adjustment needed to correct the age difference is not very large. For fathers of first-born children, income is measured in all five years as before in the paper, while the income of fathers of second-born children, is measured in 1970, 1975, 1980 and 1985 and finally the income of fathers of children who are number three or higher in the birth order position, is measured in 1970, 1775 and 1980. The appendix table A3 reports estimates from this exercise and it is clear that the birth-order pattern can not be explained by differences in the age of the fathers

at the time the income data are collected. The estimate for second-born sons in three-child-families rises from .249 to .270, and for second-born daughters in two-child-families the estimate fall from .175 to .161 so in this case the birth-order difference becomes larger. Most other changes in the estimates are at decimal level.

The data allow one of the hypotheses belonging to the main categories described in section 2 to be tested. The separation hypothesis suggests that the tendency of income elasticity to decrease with birth order may be explained by the incidence of parental separations, because they are likely to affect the later-born children the most. In the case where the children are separated from the father, a weaker income relation between the father and the later-born children may be expected. Björklund and Chadwick (2003) analyze income elasticities in both intact and separated families. They find that sons who always lived with their biological fathers have a labor income elasticity of 0.25. Sons who sometimes lived with their biological fathers have an elasticity of 0.20-0.23, while sons who never lived with their biological fathers have a very low elasticity not significantly different from zero.

To test the separation hypothesis, an analysis is made exclusively on children who lived with their fathers in 1970 and 1975, when they were ages 6-8 and 11-13, respectively. If the income elasticity would not decrease with birth order in the analysis that only includes individuals from intact families, this would be in line with a separation hypothesis. Table 7 presents the results for sons and daughters who lived with their fathers in 1970 and 1975 and where the fathers' labor income is required to be positive for at least one of the income years. The elasticity of both sons and daughters without siblings, is larger compared with the estimate in table 4, where the separated families were included. Thus there is a stronger income relation in one-child families between fathers and sons who have lived together during the son's upbringing. In families with more than one child, this effect is not present. In three-child families, the elasticity of last-born sons

in three-child families and last-born daughters in two child families have increased compared to the results in table 4. This result is weakly in line with the assumptions of a separation hypothesis.

Section 2 also discusses the "child quantity – child quality" trade-off when describing a situation where economic and social family resources become diluted as the family grows. The result found in the main analysis, that the income elasticity tends to decrease with family size for fathers and sons, is in line with the "child quantity – child quality" trade-off.

Finally, the last category, cultural factors, suggest potential reasons why birth order would affect an individual's future outcome, for example, the old tradition among farmers that the eldest son inherits the farm or the family company. To the extent that this tradition continues, one may expect higher income elasticity among first-born children.[16] The results in this paper are to some extent in line with this prediction. Table 4 shows that the estimate for first-born sons from three-child families is much larger than the estimates for middle-born and last-born sons. One way to approach this problem is to find out if there is an abundance of first-born children among the self-employed. Table 8 shows the fraction of self-employed children in different birth-order and family-size categories: there is no abundance of self-employed among first-born sons or daughters. Rather, the small differences indicate the opposite pattern. So the results are not in line with this hypothesis.

7. Conclusion

The main finding of this paper is that there seems to be birth-order and family-size patterns in the transmission of economic status between fathers and sons. The income

[16] There may, however, be problems when measuring income of farmers and the self-employed. For example, self-employed people may not report income as wages.

elasticity tends to decrease with birth order for a given family size, especially in the labor-income analysis. In large families, there is a sizable difference in income elasticity between first and last-born sons: in three child families, the estimate for first-born sons is almost twice as large and in four-child families, the estimate for first-born sons is almost three times as large. Disregarding children without siblings, the elasticity also tends to decrease with family size. These differences can not be explained by differences in the age of the fathers at the time the income data are collected and the differences in birth-order and family-size estimates are significant. The estimates for fathers and daughters show a similar but weaker elasticity pattern regarding birth order, but the differences are not significant. In the mother-daughter and mother-son samples, there are no significant birth-order or family-size effects.

The results on birth order are weakly in line with one of the predicted birth-order effects discussed in the paper. The separation hypothesis predicts a weaker income relation between an absent father and later-born children and the results for sons in three-child families and daughters in two-child families are weakly in line with this hypothesis. Still, the other estimates do not support a separation hypothesis. The birth-order differences revealed in the paper might be explained by psychological factors, such as the hypothesis that younger children regard older siblings as role models and are influenced by them rather than their parents. This may generate weaker income relations between parents and later-born children compared to first-borns or an only child.

Future research might go further to identify central mechanisms behind the dynamic process of income transmission between different family members. One task is to find out if income elasticity to some degree is connected to fertility rates and explore if that might help explain the different income elasticity levels in countries with varying fertility rates. Another task would be to replicate this study using US data. It would be interesting

to find out if there are any birth-order and family size effects in a society where the average intergenerational income elasticity is so much higher than in Sweden.

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Table 1. Sample characteristics of children

Variable	Mean	St. dev.	Min.	Max	N
Sons:					
Age in 1999	35.9	0.81	35	37	18,002
Income (SEK 1000s)	262	166	.05	8,180	18,002
Income by birth order and family size:					
No siblings	256	133	.4	965	1,289
Two-child families	271	165	.1	3,724	8,094
1st	277	182	.3	3,724	4,522
2nd	261	140	.1	2,465	3,572
Three-child families	263	178	.05	8,180	5,717
1st	269	221	.3	8,180	2,188
2nd	262	148	.3	1,796	2,097
3rd	257	142	.05	2,097	1,432
Four- or more child families	240	158	.07	5,333	2,902
1st	263	254	.2	5,333	617
2nd	232	121	.2	1,043	649
3rd	236	123	.07	1,047	754
4th	233	113	.4	953	882
Daughters:					
Age in 1999	36.0	0.81	35	37	18,813
Income (SEK 1000s)	171	96	.04	2,575	18,813
Income by birth order and family size:					
No siblings	173	101	.1	906	1,660
Two-child families	176	97	.04	2,575	8,230
1st	178	96	.04	1,217	4,490
2nd	172	99	.4	2,575	3,740
Three-child families	170	99	.1	2,113	5,810
1st	171	97	.1	1,022	2,075
2nd	172	95	.1	1,282	1,935
3rd	166	103	.2	2,113	1,800
Four-child families +	159	83	.1	944	3,113
1st	164	90	.8	944	532
2nd	158	79	.1	460	607
3rd	158	83	.4	531	804
4th	158	82	.1	819	1,170

Note: Income refers to (non-zero) labor income in 1999. The summary measures of sons come from the father and son sample while the summary measures of daughters come from the mothers and daughters sample. Income is expressed in the price level of year 2000.

Table 2. Sample characteristics of parents

Variable	Mean	St. dev.	Min.	Max	N
Fathers					
Age in 1980	45.7	4.8	33.0	55.0	18,002
Income (SEK 1000s)	238	115	.6	1,884	18,002
Income by number of children:					
One child	218	88	.8	981	1,289
Two children	240	103	4.2	1,652	8,094
Three children	245	125	.6	1,884	5,717
Four or more children	226	132	1.0	1,560	2,902
Age in 1980 by number of children:					
One child	45.7	5.2	34.0	55.0	1,289
Two children	45.3	4.7	33.0	55.0	8,094
Three children	45.7	4.9	34.0	55.0	5,717
Four or more children	46.7	4.9	33.0	55.0	2,902
Age in 1980 by birth-order position of child:					
Fathers of first-born children	43.6	4.5	33.0	55.0	8,616
Fathers of children who are no. 2	46.8	4.2	35.0	55.0	6,318
Fathers of children who are no. 3	48.9	3.9	35.0	55.0	2,186
Fathers of children who are no. 4+	50.5	3.4	38.0	55.0	882
Mothers					
Age in 1980	43.5	5.1	32.0	55.0	18,813
Income (SEK 1000s)	98	58	.3	991	18,813
Income by number of children					
One child	108	58	.3	377	1,660
Two children	100	54	.3	803	8,230
Three children	96	61	.3	991	5,810
Four or more children	87	57	.3	549	3,113
Age in 1980 by number of children:					
One child	42.7	5.6	32.0	55.0	1,660
Two children	43.1	4.8	32.0	55.0	8,230
Three children	43.5	5.1	32.0	55.0	5,810
Four or more children	45.0	5.3	32.0	55.0	3,113
Age in 1980 by birth-order position of child:					
Mothers of first-born children	41.0	4.5	32.0	55.0	8,757
Mothers of children who are no. 2	44.5	4.4	33.0	55.0	6,282
Mothers of children who are no. 3	47.1	4.1	36.0	55.0	2,604
Mothers of children who are no. 4+	48.8	3.9	38.0	55.0	1,170

Note: Income measure: average annual labor income during the years 1970, 1975, 1980, 1985 and 1990. 'Children who are no. 4+' refers to children who have birth-order position 4 or higher. Income is expressed in the price level of year 2000.

Table 3 Estimated intergenerational income elasticities. Standard errors in parentheses; sample sizes in italics. Income restrictions applied to both generations.

Variable	Labor income	Total income	Labor income	Total income
	Fathers and sons		*Mothers and sons*	
Positive income in at least one year	.280 (.013) *18,001*	.273 (.012) *18,698*	.041 (.007) *19,827*	.028 (.006) *20,852*
Positive income in every year	.305 (.016) *15,672*	.299 (.013) *17,826*	.014 (.012) *10,000*	.021 (.010) *11,550*
Income over 10,000 SEK in every year	.301 (.012) *15,097*	.319 (.010) *17,546*	.046 (.013) *8,445*	.050 (.010) *9,870*
Income over 100,000 SEK in every year	.342 (.010) *11,827*	.396 (.010) *14,747*	.266 (.038) *1,832*	.314 (.037) *2,275*
	Fathers and daughters		*Mothers and daughters*	
Positive income in at least one year	.204 (.015) *16,957*	.171 (.012) *17,646*	.043 (.008) *18,812*	.042 (.006) *19,808*
Positive income in every year	.244 (.018) *14,840*	.184 (.013) *16,847*	.073 (.013) *9,465*	.056 (.009) *11,000*
Income over 10,000 SEK in every year	.244 (.014) *14,140*	.213 (.010) *16,565*	.088 (.013) *7,886*	.091 (.010) *9,331*
Income over 100,000 SEK in every year	.259 (.010) *9,859*	.289 (.009) *13,119*	.213 (.033) *1,544*	.257 (.030) *2,034*

Table 4. Estimated intergenerational elasticities in labor income by birth order and family size. Fathers-sons and fathers-daughters samples.

No. of children in family	Birth order									
	Fathers and sons					*Fathers and daughters*				
	1	2	3	4+	All	1	2	3	4+	All
1	.237				.237	.205				.205
	(.052)				(.052)	(.062)				(.062)
	1,288				*1,288*	*1,211*				*1,211*
2	.336	.308			.326	.190	.175			.185
	(.028)	(.032)			(.021)	(.031)	(.036)			(.024)
	4,521	*3,571*			*8,093*	*4,383*	*3,257*			*7,641*
3	.356	.249	.196		.269	.275	.187	.134		.204
	(.039)	(.037)	(.040)		(.022)	(.043)	(.045)	(.046)		(.026)
	2,187	*2,096*	*1,431*		*5,716*	*2,100*	*1,860*	*1,428*		*5,390*
4+	.301	.220	.228	.110	.203	.107	.095	.393	.123	.198
	(.075)	(.060)	(.058)	(.052)	(.030)	(.077)	(.067)	(.069)	(.069)	(.035)
	616	*648*	*753*	*881*	*2,901*	*548*	*614*	*713*	*834*	*2,712*

Note: Standard errors in parentheses; sample sizes in italics. The measure of income is log labor income (annual wages before taxes, sickness benefits, parental allowances, and income from farming activity). Income is measured in 1999 for sons and daughters and in 1970, 1975, 1980, 1985 and 1990 for fathers. Positive income in 1999 is required for sons and daughters and in at least one of the income years for fathers.

Table 5. Estimated intergenerational elasticities in labor income by birth order and family size. Mothers-sons and mothers-daughters samples.

No. of children in family	Birth order							
	Mothers and sons				*Mothers and daughters*			
	1	2	3+	All	1	2	3+	All
1	.111			.111	.301			.301
	(.112)			(.112)	(.098)			(.098)
	300			*300*	*248*			*248*
2	.150	.294		.236	.235	.167		.212
	(.016)	(.017)		(.058)	(.075)	(.062)		(.049)
	427	*431*		*859*	*367*	*380*		*748*
3+	.258	.274	.346	.334	.176	.283	.062	.188
	(.108)	(.012)	(.079)	(.056)	(.096)	(.112)	(.080)	(.052)
	171	*168*	*330*	*671*	*147*	*139*	*258*	*546*

Note: Standard errors in parentheses; sample sizes in italics. The measure of income is log labor income (annual wages before taxes, sickness benefits, parental allowances, and income from farming activity). Income is measured in 1999 for sons and daughters and in 1970, 1975, 1980, 1985 and 1990 for mothers. Income over 100,000 SEK in every year is required for both generations.

Table 6. Significance tests

Test:	*P-value*
1) H_o: Restricted model: $\delta^2=\delta^3=\delta^4=\lambda^2=\lambda^2=\lambda^4=\phi^{22}=\phi^{33}=\phi^{42}=0$ H_1: General model	0.005
2) H_o: Restricted model: $\lambda^2=\lambda^2=\lambda^4=\phi^{22}=\phi^{33}=\phi^{42}=0$ H_1: :General model	0.100
3) H_o: Restricted model: $\delta^2=\delta^3=\delta^4=\phi^{22}=\phi^{33}=\phi^{42}=0$ H_1: :General model	0.113

Table 7. Estimated intergenerational elasticities in labor income by birth order and family size. Same household as the father at least in 1970 and 1975.

No. of children in family	Birth order									
	Fathers and sons					*Fathers and daughters*				
	1	2	3	4+	All	1	2	3	4+	All
1	.255				.255	.274				.274
	(.057)				(.057)	(.070)				(.070)
	1,130				*1,130*	*1,068*				*1,068*
2	.344	.264			.301	.202	.201			.204
	(.029)	(.034)			(.022)	(.032)	(.037)			(.024)
	4,329	*3,359*			*7,689*	*4,188*	*3,080*			*7,269*
3	.364	.243	.234		.282	.286	.179	.134		.205
	(.040)	(.040)	(.044)		(.024)	(.045)	(.047)	(.048)		(.027)
	2,117	*2,006*	*1,352*		*5,477*	*2,014*	*1,786*	*1,335*		*5,137*
4+	.199	.212	.252	.124	.193	.120	.136	.382	.095	.199
	(.086)	(.062)	(.061)	(.054)	(.031)	(.081)	(.072)	(.068)	(.071)	(.036)
	589	*627*	*714*	*822*	*2,755*	*528*	*588*	*680*	*771*	*2,570*

Note: Standard errors in parentheses; sample sizes in italics. The measure of income is log labor income (annual wages before taxes, sickness benefits, parental allowances, and income from farming activity). Income is measured in 1999 for sons and daughters and in 1970, 1975, 1980, 1985 and 1990 for fathers. Positive income in 1999 is required for sons and daughters and in at least one of the income years for fathers.

Table 8. Fraction of self-employed children by birth order and family size.

No. of children in family	Birth order									
	Sons					*Daughters*				
	1	2	3	4+	All	1	2	3	4+	All
1	.056				.056	.031				.031
2	.048	.054			.051	.026	.030			.028
3	.055	.054	.068		.059	.034	.037	.034		.035
4+	.058	.070	.062	.065	.064	.031	.033	.024	.023	.026

Appendix

Table A1. Estimated intergenerational elasticities in labor income between fathers and sons and fathers and daughters. Positive income in every year.

No. of children in family	Birth order									
	Fathers and sons					*Fathers and daughters*				
	1	2	3	4+	All	1	2	3	4+	All
1	.243				.243	.219				.219
	(.070)				(.070)	(.072)				(.072)
	1,082				*1,082*	*1,063*				*1,063*
2	.365	.293			.334	.229	.228			.233
	(.032)	(.037)			(.024)	(.037)	(.042)			(.028)
	4,146	*3,094*			*7,241*	*4,023*	*2,860*			*6,884*
3	.357	.305	.218		.301	.351	.201	.144		.243
	(.043)	(.046)	(.048)		(.026)	(.049)	(.052)	(.059)		(.030)
	2,002	*1,858*	*1,149*		*5,011*	*1,913*	*1,647*	*1,428*		*4,715*
4+	.209	.321	.210	.210	.238	.233	.123	.385	.145	.248
	(.090)	(.075)	(.077)	(.066)	(.038)	(.107)	(.085)	(.074)	(.093)	(.044)
	553	*552*	*636*	*591*	*2,335*	*482*	*534*	*583*	*573*	*2,175*

Note: Standard errors in parentheses; sample sizes in italics. The measure of income is log labor income (annual wages before taxes, sickness benefits, parental allowances, and income from farming activity). Income is measured in 1999 for sons and daughters and in 1970, 1975, 1980, 1985 and 1990 for fathers.

Table A2. Estimated intergenerational elasticities in total income for sons and daughters born between 1962 and 1964

No. of children in family	Birth order									
	Fathers and sons					*Fathers and daughters*				
	1	2	3	4+	All	1	2	3	4+	All
1	.382				.382	.155				.155
	(.055)				(.055)	(.048)				(.048)
	1,350				*1,350*	*1,266*				*1,266*
2	.329	.252			.294	.138	.158			.148
	(.027)	(.027)			(.019)	(.027)	(.028)			(.020)
	4,701	*3,691*			*8,393*	*4,533*	*3,392*			*7,926*
3	.292	.268	.204		.258	.243	.176	.211		.213
	(.034)	(.036)	(.034)		(.020)	(.033)	(.033)	(.041)		(.020)
	2,262	*2,174*	*1,486*		*5,924*	*2,190*	*1,933*	*1,481*		*5,606*
4+	.265	.173	.247	.172	.209	.196	.103	.221	-.001	.123
	(.057)	(.059)	(.043)	(.035)	(.024)	(.056)	(.052)	(.054)	(.046)	(.026)
	645	*671*	*788*	*921*	*3,028*	*573*	*637*	*743*	*889*	*2,845*

Note: Standard errors in parentheses; sample sizes in italics. The measure of income is log total income (annual labor income, pensions, unemployment benefits, capital income (including capital gains), and income from real estate property). Income is measured in 1999 for sons and daughters and in 1970, 1975, 1980, 1985 and 1990 for fathers. Positive income in 1999 is required for sons and daughters and in at least one of the income years for fathers.

Table A3. Estimated intergenerational elasticities in labor income between fathers and sons and fathers and daughters. Similar age of fathers*

No. of children in family	Birth order									
	Fathers and sons					*Fathers and daughters*				
	1	2	3	4+	All	1	2	3	4+	All
1	.237				.237	.205				.205
	(.052)				(.052)	(.062)				(.062)
	1,288				*1,288*	*1,211*				*1,211*
2	.336	.302			.324	.190	.161			.181
	(.028)	(.032)			(.021)	(.031)	(.035)			(.023)
	4,521	*3,571*			*8,093*	*4,383*	*3,257*			*7,641*
3	.356	.270	.196		.277	.275	.179	.134		.200
	(.039)	(.037)	(.040)		(.022)	(.043)	(.045)	(.046)		(.026)
	2,187	*2,096*	*1,431*		*5,716*	*2,100*	*1,860*	*1,428*		*5,390*
4+	.301	.228	.228	.110	.200	.107	.089	.393	.121	.191
	(.075)	(.060)	(.058)	(.052)	(.030)	(.077)	(.063)	(.069)	(.069)	(.035)
	616	*648*	*753*	*881*	*2,901*	*548*	*614*	*713*	*834*	*2,712*

Note: Standard errors in parentheses; sample sizes in italics. The measure of income is log labor income (annual wages before taxes, sickness benefits, parental allowances, and income from farming activity). *Income is measured in 1999 for sons and daughters and in different years for fathers in order to collect income at similar age. See the text (section 6.2) for more details. Positive income in 1999 is required for sons and daughters and in at least one of the income years for fathers.